Medical Science

Role of computed tomography angiography in detecting pulmonary embolism and the prevalence of it

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DISCOVERY

SCIENTIFIC SOCIETY

ABSTRACT

Background: Pulmonary embolism (PE) is an obstruction of the principal pulmonary artery, or one of its parts, by a material that has passed into the bloodstream from elsewhere in the body. PE is the third leading cause of cardiovascular-related mortality. Computed Tomography angiography (CTA) is the most technique of choice. The purpose of manuscript is to evaluate and summarize the role of imaging tools in diagnosis of PE in suspected patients, with particular focus on CTA. *Methods and materials*: This retrospective study was conducted at Taif hospitals (King AbdulAziz specialist hospital (KAASH) and King Fiasal Medical Complex (KFMC)) for two months. It included data from 1920 patients who were chosen as cases of suspected PE based on the clinical examination and referred for CTA of the chest. Patients' data were reviewed from the PACS program. Data were analyzed using Microsoft Excel version 2010. Ethical approve was obtained from our university and hospitals under investigation. Any patient with missing data or diagnosis report was excluded from study *Results*: Positive patient of PE that detected using CTA was 1130, 40 of them were not confirmed by laboratory test (D-dimer test). The most affected age range was (61-80 y) which represents 440 patient (39%) from total cases. Female patients were more affected by PE than male where they showed 620(55%) compared to 510(45%) patent in both gender. *Conclusion*: Recent data from current research associated with published data well confirmed the role of computed tomography in detecting PE.

Keywords: PE, Prevalence, CTA

1. INTRODUCTION

Pulmonary embolism (PE) is a clinically important diagnosis in the emergency department (ED) that is associated with significant morbidity and mortality. The diagnostic yield for PE was 13.6% with the majority being lobar and segmental PE (Anjum et al., 2019). PE is the third most common cardiovascular death, PE doesn't have specific symptoms like: chest pain, hemoptysis, congestive heart failure, fever, dyspnea This leads to a difficult diagnosis PE or make it challenge (Zamecka et al., 2014) .

Pulmonary artery imaging is not done in each patient, due to cost and radiation risk associated with it. Over the past few decades the incidence of PE has fallen significantly nearly 45%, however the of deep-vein thrombosis (DVT) keeps stable (Carrier et al., 2010). Precise diagnosis of PE is of significant relevance since treatment lowers mortality from 30% to <10%. There have been multiple techniques for diagnosing PE patients, these including electrocardiogram, chest radiography, echocardiography, ventilation-perfusion scintigraphy, catheter pulmonary angiography, lower extremity vein evaluation with venography, sonography, CT venography (CTV) and MR angiography. In last year's laboratory tests such as D-dimer have played an increasing role in the accurate diagnosis of patients with suspected pulmonary embolism, but computed tomography has practically become the first-line of imaging test in daily clinical routine (Zamecka et al., 2014).

The total number of pulmonary embolism is about 1 per 1,000 people in the U.S. Clinical diagnosis alone is not sufficient for patients with suspected obstructive pulmonary disease. The prevalence of pulmonary embolism that is detected when autopsies among hospital patients is 15-26%. When obstructive pulmonary disease is not treated, it is fatal in up to 30% of patients. It can be reduced to 2-10% if it is diagnosed and directly treated with anticoagulants; however, this treatment is not without risks. Therefore requires sensitive and specific diagnostic examinations (Dondelinger, 2007).

Computerized tomography pulmonary angiography (CTPA) scan is an imaging technique and gold standard in diagnosing patients with suspected pulmonary embolism (PE). CTPA is high diagnosing in thrombo-embolism in major and lateral pulmonary artery branches (Sun and Lei, 2017). CTPA has become the diagnostic imaging modality of choice for these patients. The important advantages of computed tomography (CT) over other imaging modalities are as follow: The scanning time is quick, low cost for traditional pulmonary arteries, protection, widespread availability, concurrent inspection of the lung parenchyma, and is that both madiasinal and parenchymal structures be examined and thrombus can be directly visualized. Angiography considers superior tool to chest radiography in provide a diagnosis in patients investigated for PE, even when there is no PE present (Dondelinger, 2007; Anjum, 2019; Alharbi et al. 2020).

However, in patients at low risk, PE imaging is an important tool for diagnostic evaluation of pulmonary embolism. Pulmonary arteriography is a standard reference test for pulmonary embolism, but this examination is not appropriate for the patient. Its usefulness is limited, so the aim of this study was to measure the ability to determine the diagnosis and investigate the results of the disease spread to those who were evaluated using the calculated lung. The pulmonary embolism (PE) is one of leading causes of morbidity and mortality, nearly 300,000 cases annually in the U.S. alone, revolutionizing the diagnosis of PE by introducing pulmonary computed tomography (CT-PA) is a fast and reliable diagnostic method that can exclude the presence of PE in patients with suspicious symptoms (Perelas et al., 2015).

The radiographic CT appearance for PE is divided into acute and chronic appearance (Alastair et al., 2018). (CTPA) will demonstrate filling defects with acute pulmonary emboli within the pulmonary vasculature. When the artery is seen from the thrombus in its axial plane, the central filling defect is surrounded by a thin rim of contrast, called the Polo Mint sign (Dawei et al., 2021). Emboli may be occlusive or non-occlusive, with a thin stream of contrast adjacent to the embolus being seen in the latter. In contrast to chronic emboli, the embolus usually gives the vessel an acute angle. It may also enlarge the affected vessel (Alastair et al., 2018).

As far as authors know there were a lack of studies in our local community that discuss the role of CT in diagnosing PE, so authors motivated to carry this study. The main objectives of the current study were to highlight the role of CT in detecting PE as well as to know its prevalence in Taif city, Saudi Arabia.

2. MATERIALS AND METHODS

This retrospective study was conducted at different Taif hospitals including King Abdulaziz Specialist hospital (KAASH) and King Fiasal Medical Complex (KFMC). Data retrieved from picture archiving and communication system (PACs). Study duration was from mid-December 2019 until July 2020, three months allowed for data collection phase and the next following months allowed for data analysis and writing as a second phase .The study included data from 1920 patients, 1010 males, aged (19-101) years, and 910 females, aged (17-109) years. The age groups we have chosen were (17-109), based on survey of all patients referred to radiology department for CTA and suspected with PE. Data were reviewed from the Picture Archiving and Communication System (PACS) program and a table was created with the following information: demographic information, (serial number of patient, age, and gender) weight, height, body mass index BMI, Positive / Negative, Acute / Chronic, Site, Bilateral / Unilateral, Cardiomegaly. All patients followed by hospitals record departments for checking the accuracy and specificity of CTA for three months after CTA exams.

The exclusion criteria include all patients with missing data or diagnostic report. Data collection and reporting of finding will be undertaken in manner designed to protect confidentiality of subject. Researcher used Excel program version 2010 to analyze data. Ethical approval (NO IRB KACST 276/2019) was done for both hospitals and data were collected according to this document.

3. RESULTS & DISCUSSION

The current study was aimed to assess the role of CTA in diagnosing PE as well as detected the prevalence of PE. The 1920 patients that suspected with PE after CTA examination performed for them; there were only 1130 cases that were diagnosed as PE. Most of PE cases diagnosed by CTA (960) (85%) were acute cases. In addition all positive diagnosed patients were followed. 40 out of 1130 which represented 03.5 % patients was diagnosed as PE but unconfirmed by D-dimer test, also undergone magnetic resonance imaging angiography (MRA), also unconfirmed and these may due to that clot may be moved from place to another, or might be dissolved in blood stream specially when it is small in it is size (figure 1-5 & table 1).
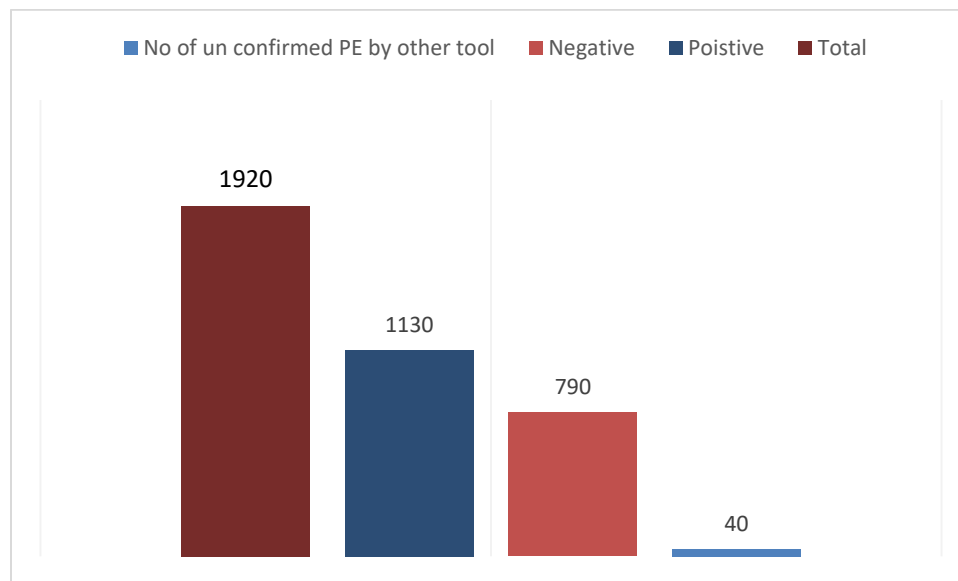

Figure 1 Shows total number of sample, positive patient of PE that detected using CTA as well as another forty patient out of 1130 has detected as positive case but unconfirmed by other diagnostic tool such as laboratory test.
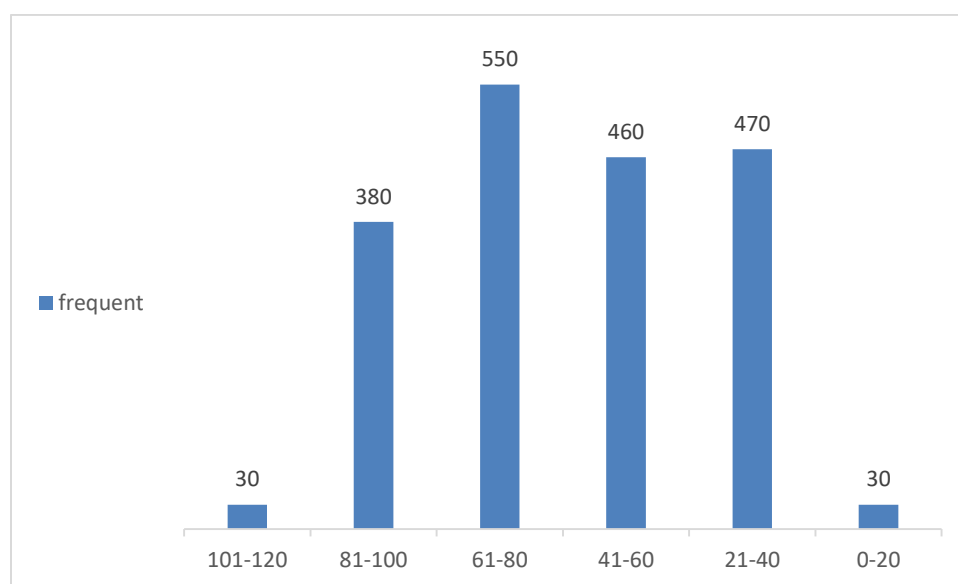

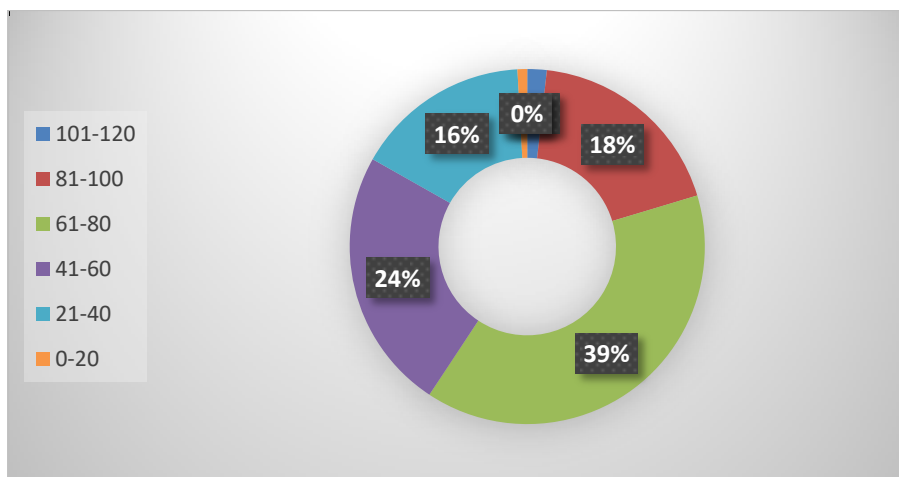
Figure 2 Shows the age range among the study sample

Figure 3 shows number of cases that detected by CTA, for different age range
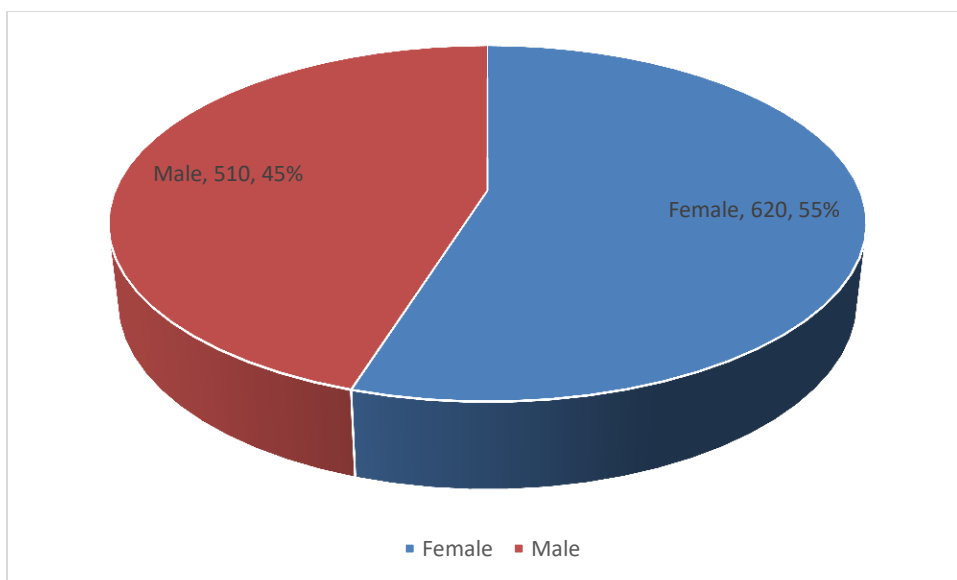

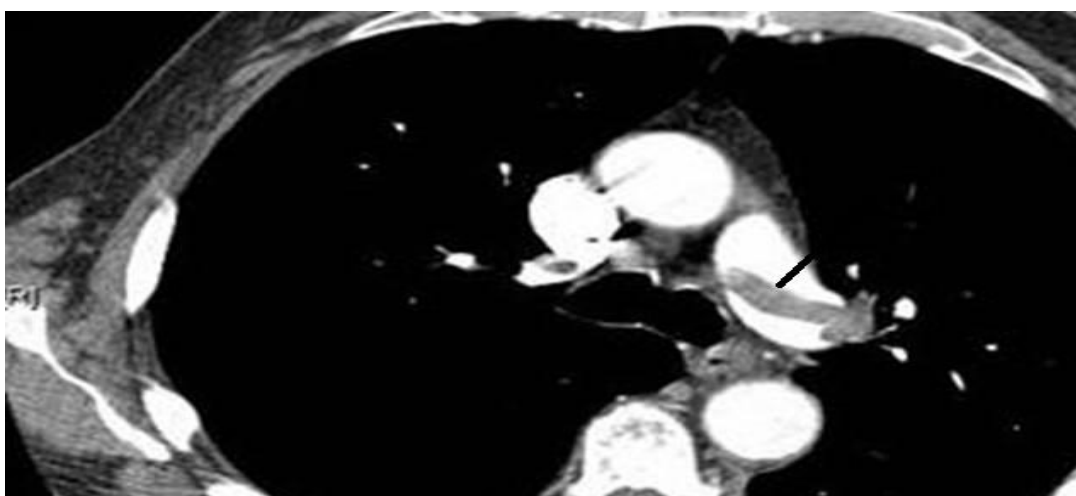**Figure 4** shows distribution of positive patients with PE among gender

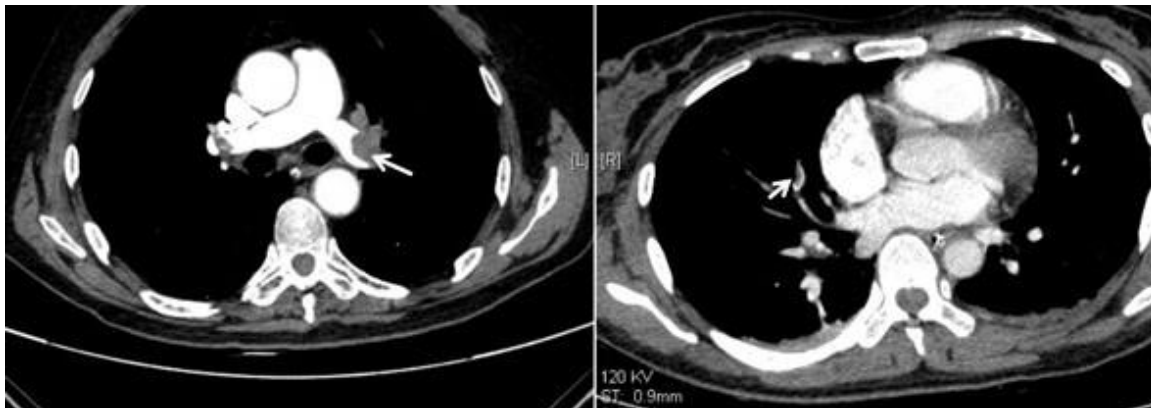**Figure 5 A** showed (arrow) PE of patient 47 years

Figure 5 B showed different phase of PE (arrowed)

Table 1 Gender distribution, positive PE, bilateral distribution and Prevalence

Gender	No	Positive PE	Prevalence %	Bilateral %
Females	910	620	68	76.9
Males	1010	510	50.4	78%

The accuracy of CTA in detecting PE in current was 96.5%. In Canadian study performed by Anderson et al., (2007), they evaluated 1417 PE-suspected patients and concluded that the accuracy was 97.5, which is some what match our findings. In addition, in another European study carried by Righini et al., (2008), where 1819 clinically suspected PE patients were randomized to assess by a D-dimer and CT-angiography strategy or D-dimer, CT-angiography and venous compression ultrasonography (CUS) of lower limbs. They concluded the accuracy of CTA in detecting PE was more than 97%. Consequently, both findings of previous studies agree with our current findings

There are still areas of uncertainty in using CTA in detecting PE. However it has a higher accuracy in diagnosing PE, the area of uncertainty concentrated at isolated sub-segmental PE, When we refereed to current patients who diagnosed as positive PE by CTA and not confirmed by D-dimer test, authors found all of them have sub segmental PE with no history of any PE or lung diseases. In previous study (Konstantinides et al., 2014) reported the positive predictive value of CTA is relatively low in the levels below segmental level that study was recommended to utilize CUS in these cases in order to rule out DVT and define if it is necessary to initiate treatment (anticoagulants). Consequently the previous study was on the line of current vision which, reported the sub segmental PE for all current patient under sample.

Figure 4 showed female were more affected by PE than male patients, detection by CTA for female was (55%), this finding agree with previous study (Carrier et al., 2010) they found that more female were under exposure of PE symptoms than male. so all cases of PE should be well diagnosed and managed specifically at early symptoms. The most affected age by PE was 61-80 as explained in figure 3 where it showed 39% and the second age group is 41-60 years, which it showed 24%. The above findings match the finding in novel previous study (Stryjewski et al., 2011) where they reported that the most affected age is 69.7 for both gender and this value represents the middle range of age group 61-80 of current study which was more affected age.

4. CONCLUSION

Computed tomography angiography has complementary roles in the accurate diagnosis of acute and chronic thromboembolic disease. Conventional angiography should be used as a problem-solving technique after CT angiography has been performed to confirm PE as CT angiography considered less invasive. PE more affected ages is between 41 to 60 years.

Limitation of the study

One of the major limitations of our study was difficult for us to search for complete patient information.

during phase of data collection, also ethical committee of ministry of health (MOH) for their efforts and support of the current project.

Author's contributions

Single author performs this study in all phases. Except data collection phase, students help author in this phase.

Informed consent

The written and verbal informed consent was obtained from all participants before enrollment in the study.

Ethical approval

Directorate of Health Affairs in Taif city approved this study (Ethical approval number: IRB KACST 276/2019). The procedures followed were in accordance with the Helsinki Declaration of 1975 that was revised in 2013.

Conflict of interest

The author declare that they are no conflict of interest

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Alastair J. E. Moore, Jason Wachsmann, Murthy R. Chamarthy, Lloyd Panjikaran, Yuki Tanabe, Prabhakar Rajiah. Cardiovasc Diagn Ther 2018; 8: 225-43.

2. Alharbi SH, Almegren M, Alshammari HA, Alanazi AH, Alshammari ZA, Alshammari SK, Alenezi AM, Ahmed HG. Appropriateness of pulmonary CT angiography testing request in patients suspected with pulmonary embolism in Hai'l Region, Northern Saudi Arabia. Med Sci, 2020, 24(106), 4190-4195

3. Anderson DR, Kahn SR, Rodger MA, Kovacs MJ, Morris T, Hirsch A, Lang E, Stiell I, Kovacs G, Dreyer J, Dennie C, Cartier Y, Barnes D, Burton E, Pleasance S, Skedgel C, O'Rouke K, Wells PS. Computed tomographic pulmonary angiography vs ventilation-perfusion lung scanning in patients with suspected pulmonary embolism: a randomized controlled trial. JAMA 2007; 298:2743-53.

4. Anjum O, Bleeker H, Ohle R. Computed tomography for suspected pulmonary embolism results in a large number of non-significant incidental findings and follow-up investigations. Emerg Radiol 2019; 26:29-35.

5. Carrier M, Righini M, Wells PS, Perrier A, Anderson DR, Rodger MA, et al. Subsegmental pulmonary embolism diagnosed by computed tomography: incidence and clinical implications. A systematic review and meta-analysis of the management outcome studies. JTH 2010; 8:1716-22.

6. Dondelinger, R. Emergency Radiology, Imaging and Intervention 2007; 423-37.

7. Konstantinides SV, Torbicki A, Agnelli G, Danchin N, Fitzmaurice D, Galiè N, Gibbs JS, Huisman MV, Humbert M, Kucher N, Lang I, Lankeit M, Lekakis J, Maack C, Mayer E, Meneveau N, Perrier A, Pruszczyk P, Rasmussen LH, Schindler TH, Svitil P, VonkNoordegraaf A, Zamorano JL, Zompatori M; Task Force for the Diagnosis and Management of Acute Pulmonary Embolism of the European Society of Cardiology (ESC). 2014 ESC guidelines on the diagnosis and management of acute pulmonary embolism. Eur Heart J 2014; 43:3033-69.

8. Perelas A, Dimou A, Saenz A, Rhee JH, Teerapuncharoen K, Rowden A, Eiger G. Incidental findings on computed tomography angiography in patients evaluated for pulmonary embolism. Ann Am Thorac Soc 2015; 12: 689-95.

9. Righini M, Le Gal G, Aujesky D, Roy PM, Sanchez O, Verschuren F, Rutschmann O, Nonent M, Cornuz J, Thys F, Le Manach CP, Revel MP, Poletti PA, Meyer G, Mottier D, Perneger T, Bounameaux H, Perrier A. Diagnosis of pulmonary embolism by multidetector CT alone or combined with venous ultrasonography of the leg: a randomised non-inferiority trial. Lancet 2008; 9621:1343-52.

10. Stryjewski PJ, Krupa E, Januś B, Cubera T, Nessler B, Badacz L, Nessler J. Epidemiologiazatorowościpłucnej u pacjentówoddziałukardiologicznegom [Epidemiology of pulmonary embolism in patients with cardiac. Przegl Lek 2011; 68:588-91.

11. Sun, Z. and Lei, J. Diagnostic yield of CT pulmonary angiography in the diagnosis of pulmonary embolism: A single center experience. Intervent Cardio 2017; 095, 191–8.

12. Wang D, Yang F, Zhu X, Cui S, Dong S, Zhang Z, Zhang Y. CTPA pulmonary artery distensibility in assessment of severity of acute pulmonary embolism and right ventricular function. Medicine (Baltimore). 2021; 100:e24356.

13. Zamecka, M. O., Kurys-denis, E. and Krupski, W. Diagnostic value of computed tomography (CT) angiography in patients with acute pulmonary embolism. J Pre-Clin Clin Res 2009; 3:5-10.